SOMAIYA VIDYAVIHAR UNIVERSITY

Semester: June – Sep 24 **Maximum Marks: 50 Examination: ETE Exam Date: 6/11/2024 Duration: 2 Hours**		
Programme code: 1 **Programme: MBA**	**Class:** FY	**Semester/Trimester: I**
College: K. J. Somaiya Institute of Management	**Name of the department/Section/Center: Business Analytics**	
Course Code: 317P01C103	**Name of the Course: Decision Science**	

Instructions:

1. **All questions are compulsory. There is an internal choice in Que 1B and in Que 3.**
2. **Make suitable assumptions if required and state them.**
3. **Write all relevant answers and interpretations in your Excel sheet, with sufficient details in an easily readable manner to enable a fast evaluation of your answers.**
4. **Keep saving the file every ten minutes or so.**
5. **Make only 1 Excel file with different worksheets pertaining to each question.**
6. **The naming convention for the file should have your roll number and name.**
7. **Please follow the instructions of the faculty/IT staff on duty.**

Question No.		Max. Marks
1A	**Precision Tech Solutions Ltd- Sales** To stay competitive in the global business environment, effective planning regarding scheduling, inventory, production, distribution, purchasing, and so on is very important as it is considered as the backbone of fruitful operations. Appropriate prediction of products plays a pivotal role in reducing unnecessary inventory and smoothing planning issues which result in increasing profit. Precision Tech Solutions Ltd, a leading industrial engineering company, has been observing the demand for its precision tools over the last few years. The company wants to forecast the demand for its precision tools for the next month to optimize production schedules and inventory management. The dataset provided contains monthly sales data of precision tools.The data includes the number of units sold per month.	10

Month	sales (in Lacs)	Month	sales (in Lacs)
Jan-21	48	Sep-21	60
Feb-21	41	Oct-21	48
Mar-21	37	Nov-21	41
Apr-21	32	Dec-21	30
May-21	36	Jan-22	34
Jun-21	31	Feb-22	33
Jul-21	43	Mar-22	38

	Aug-21	52		Apr-22	32		

a. Plot the graph and identify the components of the time series.

b. Calculate the 3-month, 4-months & 5 months moving average forecasts with Mean squared Error.

c. Which method is better and why?

d. Predict the forecast for May-22 using the best method .

1B

Oranges are grown, picked, and then stored in warehouses in Tampa, Miami, and Fresno with the following supply:

Warehouse	Supply
Tampa	200
Miami	200
Fresno	200

These warehouses supply oranges to markets in New York, Philadelphia, Chicago, and Boston which have the following demands for oranges:

Market	Demand
New York	130
Philadelphia	170
Chicago	100
Boston	150

The following table shows the shipping costs per truckload (in hundreds of dollars). Because of an agreement between distributors, shipments are prohibited from Miami to Chicago:

		Market			
		New York	Philadelphia	Chicago	Boston
Warehouse	Tampa	9	14	12	17
	Miami	11	10	-	10
	Frenso	12	8	15	7

Solve the problem to determine the minimum shipping cost.

OR

Carolina Airlines, a small commuter airline in North Carolina, has six flight attendants that it wants to assign to six monthly flight schedules in a way that will minimize the number of nights they will be away from their homes. The numbers of nights each attendant must be away from home with each schedule are given in the following table:

	Schedule					
Attendant	A	B	C	D	E	F
1	7	4	6	10	5	8
2	4	5	5	12	7	6
3	9	9	11	7	10	8
4	11	6	8	5	9	10
5	5	8	6	10	7	6
6	10	12	11	9	9	10

Identify the optimal assignments that will minimize the total number of nights the attendants will be away from home.

5

2

In a manufacturing plant, the weight of raw materials used to produce high-precision components is normally distributed with a mean weight of 50 kg and a standard deviation of 8 kg. If the weight of the raw material batch is less than 40 kg, it is considered underweight and requires reprocessing in a special unit. From historical data, it is known that the reprocessing time follows a uniform distribution between 5 and 30 hours, with each hour of reprocessing incurring a cost of ₹2000. Simulate the need for reprocessing for 40 batches of raw material and determine how many batches require reprocessing and the total reprocessing costs incurred.

a. What percentage of the 40 raw material batches are underweight and need reprocessing?

b. What is the average reprocessing time for the batches that are underweight?

15

3	Little Investment Advisors is working with a client on determining an optimal portfolio of bond funds. The firm suggests six different funds, each with different expected returns and risk measures (based on historical data):	20

Bond Portfolio	Expected Return	Risk Measure
1. Ohio National Bond Portfolio	6.11%	4.62
2. PIMCO Global Bond Unhedged Portfolio	7.61%	7.22
3. Federated High Income Bond Portfolio	5.29%	9.75
4. Morgan Stanley UIF Core Plus Fixed Income Portfolio	2.79%	3.95
5. PIMCO Real Return Portfolio	7.37%	6.04
6. PIMCO Total Return Portfolio	5.65%	5.17

The client wants to invest $350,000. What would be the optimal investment strategy if the client wants to minimize risk subject to the following:

a. Achieve a return of atleast 6%.

b. The client wants to invest at least $50,000 in the Federated High Income Bond fund?

c. No investment can exceed the limit of $100,000.

OR

Benson Electronics manufactures three components used to produce cell telephones and other communication devices. In a given production period, demand for the three components may exceed Benson's manufacturing capacity. In this case, the company meets demand by purchasing the components from another manufacturer at an increased cost per unit. Benson's manufacturing cost per unit and purchasing cost per unit for the three components are as follows:

Source	Component 1	Component 2	Component 3
Manufacture	$4.50	$5.00	$2.75
Purchase	$6.50	$8.80	$7.00

Manufacturing times in minutes per unit for Benson's three departments and the total available hours in each department are as follows:

	Manufacturing Time in minutes per unit			
Department	**Component 1**	**Component 2**	**Component 3**	**Hours Available**
Production	2	3	4	360
Assembly	1	1.5	3	250
Testing & Packaging	1.5	2	5	300

Assume that component demands that must be satisfied are 6000 units for component 1, 4000 units for component 2, and 3500 units for component 3. Considering the demand constraints above, given below is the linear programming model developed to determine the number of units of each component to manufacture and the number of units of each component to purchase such that the total manufacturing and purchasing cost is minimised.

Let M_1 = units of component 1 manufactured

M_2 = units of component 2 manufactured

M_3 = units of component 3 manufactured

P_1 = units of component 1 purchased

P_2 = units of component 2 purchased

P_3 = units of component 3 purchased

$$\text{Min } 4.50M_1 + 5.00M_2 + 2.75M_3 + 6.50P_1 + 8.80P_2 + 7.00P_3$$

$$\begin{aligned}
\text{s.t. } & 2M_1 + 3M_2 + 4M_3 \le 21{,}600 \text{ Production} \\
& 1M_1 + 1.5M_2 + 3M_3 \le 15{,}000 \text{ Assembly} \\
& 1.5M_1 + 2M_2 + 5M_3 \le 18{,}000 \text{ Testing/Packaging} \\
& M_1 + 1P_1 = 6{,}000 \text{ Component 1} \\
& 1M_2 + 1P_2 = 4{,}000 \text{ Component 2} \\
& 1M_3 + 1P_3 = 3{,}500 \text{ Component 3} \\
& M_1, M_2, M_3, P_1, P_2, P_3 \ge 0
\end{aligned}$$

Solve the above using Solver and generate the sensitivity report to answer the following questions:

a. What is the optimal solution? How many units of each component should be manufac tured and how many units of each component should be purchased?

b. If an extra hour was available in the assembly department, how would it impact the manufacturing cost? Should Benson avail that extra hour?

c. Now suppose that extra 500 hours are available in both Production as well as testing and Packaging department, then how would this change impact the total cost?

d. Benson observed that demand for component 2 is 4500 on an average and not 4000. Explain what implications will this have on the cost.

e. Interpret the range of optimality for the manufacturing costs of all the three components.